Claims

1. A coolant pump (1) for a coolant circuit (2) of an automotive internal combustion engine (10) including at least a radiator circuit (4) and a bypass circuit (8), which comprises:
   - a coolant pump housing (14) having an intake pipe (22) for the supply (ZK) from the radiator (6), a bypass pipe (24) for the supply (ZB) from the bypass circuit (8), and a pressure pipe (34) for the supply (ZM) of coolant to the automotive vehicle engine (10),
   - a coolant pump electric motor (26) arranged in the coolant pump housing (14), the motor housing (28) of which is situated in the coolant flow, and which drives a pump impeller (32) through the intermediary of a pump shaft (30), and
   - a directional control valve (40) integrated into the coolant pump housing (14),

   characterized in that

   - the intake pipe (22) is arranged in the area (42) of the end (44) of the pump motor (26) facing away from the pump impeller (32),
   - the bypass pipe (24) is arranged in an area (42) situated downstream of the intake pipe (22),
   - the pressure pipe (34) is arranged in an area (42) situated downstream of the bypass pipe (24), and
   - only the coolant (KZK) that can be taken in by the intake pipe (22) as a supply (ZK) from the radiator (6) may be taken past the pump motor (26) in a peripheral flow (50) through a flow channel (56) preferentially defined by the outer wall (52) of the pump motor housing (28) and the facing inner wall (54) of the pump housing (14) and/or the facing inner wall (60) of the directional control valve (40).

2. The coolant pump (1) in accordance with claim 1, characterized in that the coolant (KZB) of the bypass circuit (8) that may be taken in through the

bypass pipe (24) may be admixed to the coolant (KZK) arriving from the radiator circuit (4) with the aid of the directional control valve (40), wherein an outlet (62) of the bypass pipe (24) adapted to be opened and closed again with the aid of the directional control valve (40) is disposed in an area (42) upstream of the pump impeller (32).

3. The coolant pump (1) in accordance with claim 2, characterized in that the outlet (62) of the directional control valve (40) is disposed in an area (42) between the pump impeller (32) and the downstream end (64) of the flow channel (56).

4. The coolant pump (1) in accordance with any one of claims 1 to 3, characterized in that the pump motor (26) and the pump shaft (30) are arranged coaxially with the longitudinal axis X of the pump housing (14).

5. The coolant pump (1) in accordance with any one of claims 1 to 4, characterized in that the flow channel (56) defined by the outer wall (52) of the motor housing (28) enclosing the pump motor (26) and the facing inner wall (54) of the pump housing (14) and/or the facing inner wall (60) of the directional control valve (40) has an annular cross-section through which the coolant (KZK) that can be taken in through the intake pipe (22) for the supply (ZK) from the radiator (6) may be taken past the pump motor (26) in a peripheral flow (56) annularly enclosing the motor housing (28).

6. The coolant pump (1) in accordance with any one of claims 1 to 5, characterized in that the flow channel (56) has a cross-section (66) that is constant in the direction of flow, wherein a constriction from the diameter present at the end of the flow channel (56) to the inner diameter (70) of the pressure pipe (34) takes place from the downstream end (68) of the pump motor (26) to the pump impeller (32).

7. The coolant pump (1) in accordance with any one of claims 1 to 6, characterized in that the directional control valve (40) may be switched continuously from a closed position of "bypass closed" into an open position of "bypass open."

8. The coolant pump (1) in accordance with any one of claims 1 to 7, characterized in that the directional control valve (40) has the form of a valve spool (72) slidingly displaceable in the longitudinal direction X of the coolant pump (1).

9. The coolant pump (1) in accordance with claim 8, characterized in that the valve spool has the form of a cylindrical sleeve (72).

10. The coolant pump (1) in accordance with any one of claims 8 or 9, characterized in that the valve spool (72) may be displaced by an actuator such as, e.g., an operating solenoid (76), a thermally expandable element (112), a hydrostatic pressure member, etc.

11. The coolant pump (1) in accordance with any one of claims 8 to 10, characterized in that the valve spool (72) has downstream in the area of the outlet (62) a radially inner, annular peripheral seal (86), which in the closed postion, "bypass closed", of the directional control valve (40) sealingly closes the outlet (62) thereof by means of an end face (88) against an annular seal seat (90) of the pump housing (14), and/or in the open condition, "bypass open", sealingly closes the flow channel (56) by means of a radially inwardly directed seal lip (92) against the pump motor housing (28) or the pump shaft housing (94).

12. The coolant pump (1) in accordance with claim 11, characterized in that the radially inwardly directed surface of the seal (86) has a contour corresponding to the opposite contour of the motor housing (28) or of the pump shaft housing (94).

13. The coolant pump (1) in accordance with any one of claims 8 to 12, characterized in that the operating solenoid (76) of the valve spool (72) includes an armature (74) formed by the cylindrical sleeve of the valve spool (72).

14. The coolant pump (1) in accordance with claim 13, characterized in that the operating solenoid (76) includes a coil carrier (78) arranged in the pump housing (14) and enclosing the armature (74).

15. The coolant pump (1) in accordance with any one of claims 1 to 14, characterized in that downstream following the bypass pipe (24) and still upstream of the pump impeller (32), a return flow (38), e.g. for a heating circuit, a transmission oil heat exchanger, a lubricant oil heat exchanger, a cylinder block cooling circuit or the like, merges into the pump housing (14).

16. The coolant pump (1) in accordance with any one of claims 1 to 15, characterized in that the pump housing (14) is constructed in two parts (16, 18).

17. The coolant pump (1) in accordance with any one of claims 1 to 16, characterized in that the operating solenoid (76) has coil terminals (96) oriented in the longitudinal direction X, which may by means of correlating terminals (98) be taken into contact with control means (100) accommodated in the other housing part (18) such as a CPU etc., upon joining together the two housing parts (16, 18).

18. The coolant pump (1) in accordance with any one of claims 1 to 17, characterized in that in addition to driving the pump impeller (32) by the coolant pump electric motor (26), a drive wheel (106) is provided which is arranged coaxially with the pump shaft (30) externally of the pump housing (14) and coupled to the pump shaft (30) via a free-wheel (108).

19. The coolant pump (1) in accordance with any one of claims 1 to 18, characterized in that the thermally expandable element (112) is in operative connection with the directional control valve (40) via connection lines (122, 124) such that the directional control valve (40) may be switched hydraulically through a volume change of the thermally expandable element (112).

20. The coolant pump (1) in accordance with any one of claims 1 to 19, characterized in that the thermally expandable element (112) is formed of wax, the temperature-dependent volume change of which may be transferred to the hydraulically actuatable valve spool (72) via a separate coolant (120) and connection lines (122, 124).

21. The coolant pump (1) in accordance with any one of claims 1 to 20, characterized in that the thermally expandable element (112) formed of wax is arranged in an area adjacent the pressure pipe (34) in the pump housing (14) and is separated from the associated, separate coolant (120) through a diaphragm (116), such that a temperature-dependent volume change of the thermally expandable element (112) may be transferred to the coolant (120), which in turn may be displaced via the connection lines (122, 124) into a cylinder chamber (126) of the valve spool (72) thus adapted to be actuated hydraulically.

22. A method for conveying coolant by means of a coolant pump (1) for a coolant circuit (2) of an automotive internal combustion engine (10) comprising at least a radiator circuit (4) and a bypass circuit (8), comprising the steps:

- supplying the coolant from the radiator (6) to the coolant pump (1) through an intake pipe (22) of the coolant pump housing (14) for the supply (ZK),
- supplying the coolant from the bypass circuit (8) to the coolant pump (1) of the coolant pump housing (14) through a bypass pipe (24) for the supply (ZB),
- returning the coolant from the coolant pump (1) to the automotive vehicle engine (10) through a pressure pipe (34) for the coolant return (ZM),
- circulating the coolant (1) by means of a pump impeller (32) arranged in the coolant pump housing (14) and driven by a coolant pump electric motor (26) via a pump shaft (30), wherein the engine (26) is situated in a flow of the coolant,

- adjusting the mixing ratio of the coolant flows circulating through the coolant pump by means of a directional control valve (40) integrated into the coolant pump housing (14),

characterized in that

- the coolant arriving from the radiator (6) is supplied via the intake pipe (22) in the area (42) of the end (44) of the pump motor (26) facing away from the pump impeller (32),
- the coolant arriving from the bypass is supplied via the bypass pipe (24) in an area (42) located downstream of the intake pipe (22),
- the coolant is taken away via the pressure pipe (34) in an area (42) located downstream of the bypass pipe (24), and
- only the coolant (KZK) supplied from the radiator (6) through the intake pipe (22) as a supply (ZK) is taken in a peripheral flow (50) past the pump motor (26) through a flow channel (56) preferentially defined by the outer wall (52) of the pump motor housing (28) and the facing inner wall (54) of the pump housing (14) and/or the facing inner wall (60) of the directional control valve (40).

23. The method in accordance with claim 22, characterized by at least one of the features of claims 1 to 21.